first one in America to receive that degree from an American university for work done in meteorology, but has also carried on a course of thirty lectures on climatology before the graduate students in the department of geology in Johns Hopkins University. He has also given lectures to the teachers of the public schools of Baltimore. During the coming year it is expected that the lectures to university students will be continued and a still more extensive course on climatology will be given to the teachers of the city. The recent efforts of this university to reach the teachers of public schools in Baltimore, though the lectures by Drs. Fassig and Shattuck have been remarkably successful and one might suggest that an effort be made, in a similar way, to reach the teachers in the whole State of Maryland.

Why should not the State Normal schools and similar organizations engage Weather Bureau men to carry on systematic instruction in meteorology? The Editor is often asked to recommend a good text-book. Why may he not also have an opportunity to recommend a good lecturer? Such talks as are given by many of our observers would, we are sure, be a welcome and popular addition to the courses of instruction in summer schools and other places where the teachers are accustomed to congregate, and where they get new ideas and advanced methods in school work.

THE CONFLICT OF MAN WITH THE CLIMATE.

A correspondent inquires whether plants have any influence upon climate, and complains that the destruction of pine forests in southern Alabama seems to have produced disastrous droughts, and that the climate has entirely changed in that section. The following extracts from the Editor's reply are applicable to occasional similar complaints from other parts of the country:

You will find much information as to the influence of trees upon climate in Bulletin No. 7 of the Forestry Division of the Department of Agriculture. As to the general influence of vegetation upon the weather, this matter has been discussed in a popular and indefinite manner for many generations, but the technical or scientific discussion has long since been abandoned, as it is certain that the influence of vegetation upon the weather is quite inappreciable. Our weather at the ground depends upon the clearness of the sky, and that depends principally upon the clouds, which in turn depend upon the moisture in the air. The fundamental question is whether the air is ascending to make clouds or descending to make clear, dry weather, or whether moist air will cool by radiation and form a temporary fog during the night.

With regard to any possible injurious change in the amount of rainfall or in the climate in your locality, which seems to be the feature that you especially refer to, I would say that the records of the past century do not support the idea that there has been any permanent change. Everywhere throughout the globe the rainfall is subject to great variations as to its amount and the manner in which it falls; sometimes at night and sometimes by day; sometimes in many little showers and sometimes in a few heavy floods; sometimes droughts in summer and rains in winter; at other times rains in summer with dry winters, but no steady secular changes are known. The oscillations are so frequent and sometimes so extreme that they set at naught all attempts to foresee them. In general, droughts that really injure vegetation are not confined to small regions, but extend over half a continent, and may move slowly but regularly around the whole globe in the course of two or three years. The injury done by a drought is due, not so much to the lack of rain as to the drying influence of the air and the wind. Often there is enough moisture in the soil, down to depths of 3 to 6 feet, to supply all the needs of vegetation during a year's drought, provided only it can be properly conserved; but, in fact, it rises to the surface and is wasted by the drying wind, in place of being utilized by the plant. Prof. Milton Whitney, Chief of the Division of Soils, has pointed out regions in California where such great amounts of moisture are stored away in the deep soil and such admirable conditions exist in the surface soil that the moisture is conserved indefinitely and the plants thrive without either rain or artificial irrigation.

Inasmuch as we know that droughts and floods, storms and frosts must have frequently occurred in any given locality, therefore, when we cultivate the land and plant our crops, we do so in full knowledge of the impending chances of disaster, and have no right to expect uninterrupted immunity and prosperity. Never in the history of the world has it ever been possible for any one to carry out to successful completion his schemes and plans without an intense struggle against all forms of opposition. In this struggle it is not so much the strongest will as it is the highest intellect that succeeds. In the course of time almost every one, by studying his own surroundings, learns enough to enable him to achieve a moderate amount of success in any new enterprise. So far as the weather is concerned, the Weather Bureau will send you the earliest possible predictions, so that you may take precautions against injury from wind or flood or frost.

Man is so constituted that, although individuals may fail, yet the race, as a whole, is being steadily improved and developed by its conflict with nature.

WIDESPREAD AREA OF DROUGHT OR COLD.

In connection with the severe winter and spring of 1899, the editor of the Boston Journal (April 8) calls attention to the curious psychic phenomenon that in New England the belief that the climate had become milder has now changed about, and old inhabitants are inclined to acknowledge that the old-fashioned winters have come back again. On the other hand, in the Southern States the popular belief is that the climate has suddenly become more severe, forgetting that equally severe winters have occasionally occurred in that section ever since the country was first settled. We must, therefore, conclude that there has been no change in the average climate of either the northern or southern regions.

The Editor would call attention to the fact that in the South the severe winter of 1835 was preceded and followed by other winters of extraordinary harshness, and so was the memorable winter of 1886 and that of 1894–95, and so finally that of 1898–99. It might almost be accepted as a rule that the severest winters are but the climaxes of periods of unusual refrigeration. Between these cold periods come the warm years.

In the MONTHLY WEATHER REVIEW for 1896 we several times called attention to the fact that a disastrous drought is usually the result of the cumulative effect of several years of light rain or drought; also that such droughts are not confined to a small region, but move slowly during several years over the face of the globe. The gradual spread of the great cloud of vapor and dust ejected from the volcano of Krakatoa in July, 1884, lasted for several years. During the first few months it quickly surrounded the globe in the equatorial region, then it spread slowly north and south until its influence was felt in latitude N. 60° and S. 50°. One can but suppose that this demonstration of the gradual overflow of vapor in the upper regions from the equator toward either pole also applies to frequent analogous overflows of hot air, electrified air, and possibly other meteorologic elements. If this hypothesis be allowable, it will be worth while to seek for many diverse confirmations of the general rule that at any place throughout the globe any remarkable period of warm or cold, dry or wet weather is but the culmination of a series of less remarkable phenomena of the same character. This idea can be best tested by a series of daily maps like those of the Bulletin of International Simultaneous Meteorological Observations, or by the monthly maps that Professor Hildebrandson has prepared. Such studies must lead to seasonal forecasts on a correct basis of observation and induction.

RAINFALL AT HIGH STATIONS.

The hydrographer to the United States Geological Survey, Mr. F. H. Newell, as also his assistant, Mr. Henry A. Pressey, desire to call attention to the fact that inasmuch as Weather Bureau stations of all kinds are generally located in river

valleys or lowlands, therefore the records of rainfall represent the valleys and not the hilltops. This is a very serious matter in mountainous countries, and especially in those portions of the United States where it is important to know the quantity of water available for irrigation.

Mr. F. H. Brandenburg, of Denver, has labored with great success to overcome this difficulty in Colorado. By his unceasing efforts he has secured a large number of rain and snow observations at high altitudes where the rainfall is many times as great as in the valleys. It is now necessary to make a special effort of similar nature with reference to California, Arizona, and New Mexico, and, in general, for the whole arid and Plateau regions. Cases have occurred in western Montana, where the flow of water from a small stream was two or three times as great as the rainfall on its watershed, so far as that could be inferred from a few rainfall stations in the lower valley. Evidently these latter gave no idea whatever as to the rain and snow on mountain tops, from which the river derived its great excess of water. There can be no proper determination of the amount of water available for irrigation, and no explanation of the variable heights of water in the rivers unless we have a sufficient number of gages at high and low stations. Every opportunity to secure a new rainfall observer should be gladly embraced.

PHYSICS AND METEOROLOGY IN THE UNIVERSITIES.

The progress of meteorology depends not merely upon the observer and the compiler of daily weather maps, but more than anything else upon the education of the physicists who are attracted to this branch of science. The study of physics embraces every detail of the many ways in which force acts upon matter. The study of heat, light, or electricity, is the study of the phenomena that are manifested when molecules and atoms interact upon each other. The study of projectiles, the flow of water in the rivers, the motions of the atmosphere, or the tides of the ocean is the study of the action of larger masses of matter under the influence of such forces as the attraction of gravitation, the repulsion due to heat, the centrifugal force due to inertia. We may experiment upon small quantities of air and aqueous vapor in the physical laboratory, and thus learn some of the details as to the physical properties of the atmosphere; but the meteorological phenomena on a large scale can only be studied by means of the daily weather map and with the help of mathematical formulæ, or equivalent graphic methods peculiar to hydrodynamics and thermodynamics. It is evident, therefore, that important progress in meteorology is not to be hoped for from those who only frame hypotheses and speculations as to possible laws that may control atmospheric phenomena. Such hypotheses are often important; it is well said that even the clear statement of a difficulty, or of a problem, is already a long step toward its solution. But the solution is the final step that meteorology demands, and the one that is absolutely essential in order that we may really make true progress. Meteorology presents many unsolved problems, and many more will be recognized as time goes on. The successive steps involved in resolving these problems usually consist of (1) a series of successive hypotheses; (2) the testing of each hypothesis by comparison with observation and the laws of physics; (3) the modification of the hypotheses until we attain one that harmonizes with all that is known on the subject. This process involves a training in mathematics and physical experimentation, and a development of an insight into the ways of nature that does not come naturally to every one. Sir Isaac Newton is an example of those who, by persistent thought and carefully checking every step by comparison with nature, at last penetrate into some of nature's secrets.

Most of us must be content to be good observers, computers, and workers. A few may become bold and successful forecasters, but it is not likely that important additions to our knowledge of fundamental points in meteorology will be made by any except those who have gone through a severe training in the physical laboratories and methods of original research. Therefore, those interested in the progress of our science must look about with some solicitude inquiring what is being done in our American universities to turn the thoughts of earnest students toward meteorology as a branch of physics. Universities are distinguished from colleges in that they offer young men and women special opportunities for original research. They do not usually confer the degree of doctor of physics (Ph.D.) or doctor of science until the student has prepared one or more papers based on his own studies and work, and containing some substantial additions to our knowledge. A slight examination of the titles of these theses during the past few years shows that scarcely one has taken for his subject any problem that is strictly meteorological. This is probably not due to a want of interest in our science on the part of the student or the general public, but may often be traced back to the teacher himself. The universities generally prefer to consider meteorology as a rather insignificant division of the physical sciences; some of them class it with astronomy, others with geography, but in general none of them give it any prominence in the curriculum of studies, or have any special conveniences for instruction therein.

As many of our readers are turning their attention strongly toward meteorology, and inquiring as to courses of study and the attainment of the post graduate degree of Ph. D. in this science, we recommend them to examine the "Graduate Handbook" for 1899, which is published by the Federation of Graduate Clubs, and is intended to show the present condition of graduate instruction.

THE CLIMATE AND CROP SERVICE IN PORTO RICO.

The Porto Rico Section of the Climate and Crop Service of the Weather Bureau was established in the summer of 1898, and its publications have hitherto consisted of weekly bulletins, showing especially the condition of the crops. It was, of course, very desirable that the monthly reports of this section should be printed in quarto form, conformably to the general plan of publication adopted for all of the forty-five sections of this service. But both the difficulty and the expense of such a publication in Spanish and English have hitherto stood in the way, and at first it did not seem possible to overcome these. But now an arrangement has been made by which the composition, chalk-plate work, and printing are done by Mr. E. A. Evans, Section Director at Richmond, Va., while the manuscript is supplied by Mr. R. M. Geddings, the Section Director at San Juan. It is, therefore, to the cooperation of these two directors and to their proverbial enthusiasm that we owe the publication of the report of the Porto Rico Section for May, 1899, as Volume I, No. 1 of the series. Possibly, the report for December, 1899, may be followed by a summary of the whole year so complete as to represent all that the Weather Bureau has done since the summer of 1898.

This first number gives, as usual, full page sketch maps of Porto Rico, with the mean monthly temperature, wind, and rainfall for May, 1899. The isotherm of 80° F. probably skirts the greater part of the southern and northern coast lines; it cuts off a small portion of the eastern end of the island and a much larger portion of the western end. A small area of mean temperature of 82° F. exists in the south-